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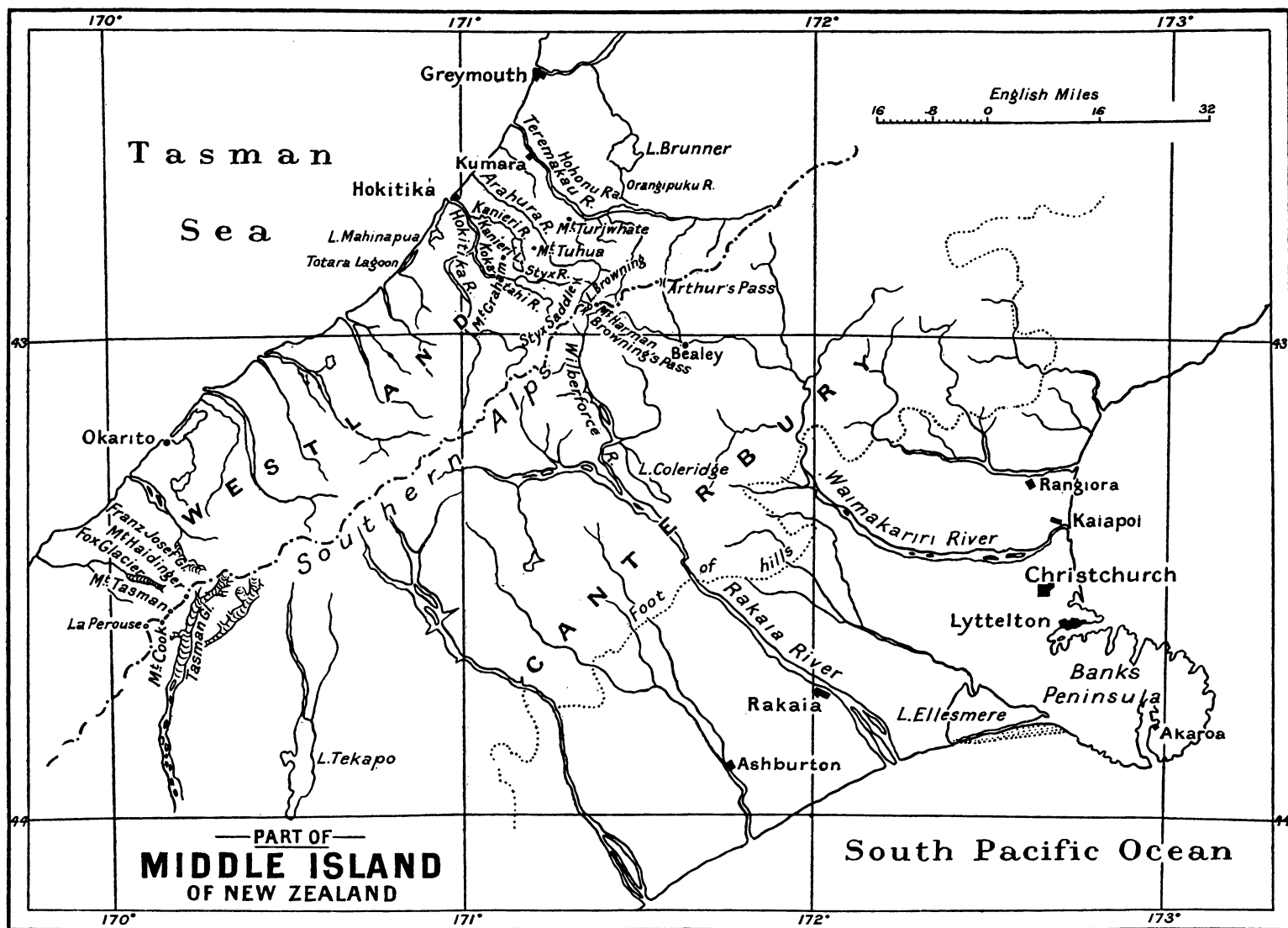
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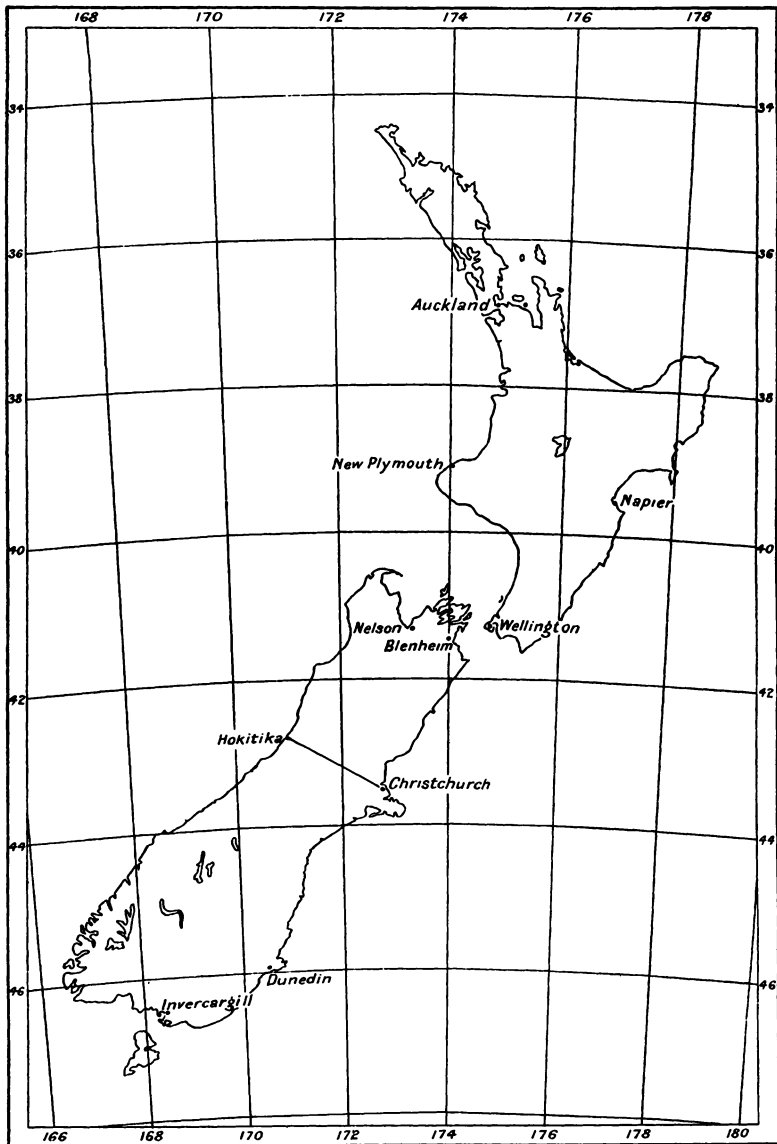
A PHYSIOGRAPHIC SECTION THROUGH THE MIDDLE
ISLAND OF NEW ZEALAND.

The Middle Island of New Zealand, considering its relatively small size, presents a remarkably varied topography. A physiographic section from the city of Christchurch, capital of the province of Canterbury, to the town of Hokitika, capital of the province of Westland, exhibits many of the most interesting physical features. A line drawn from Christchurch to Hokitika is almost at right angles to both coasts of the Middle Island, and to the majestic Southern Alps, which form the backbone of the Island. Hokitika lies about 105 miles North 55' West of Christchurch: in latitude $42^{\circ} 43'$ South: the latitude of Christchurch being $43^{\circ} 33'$ South.

On the western slope of the mountains, the main rivers—the Taramakau, the Arahura, and the Hokitika—flow to Tasman Sea in a general northwesterly direction, while, on the opposite slope, the Rakaia, with its tributary the Wilberforce, and the Waiamakariri have a general southeasterly flow to the Pacific Ocean. In other words, the main drainage channels are almost at right angles to the island-divide. The descent towards the west is much more rapid than towards the east, the distance from the ocean being on the one hand approximately 29 miles and on the other about 76 miles.

Looking from the summit of Mount Harman, which ascends some hundreds of feet above Browning's Pass, at the head-waters of the Arahura and of the Wilberforce, on a clear day one can see in the distance to the westward the broad expanse of the Tasman Sea, and to the eastward the mighty bosom of the Southern Pacific. North-eastward and south-westward runs the backbone of the Middle Island, the great mountain-chain of the Southern Alps. To the south-westward the chain can be seen gradually to increase in altitude, culminating in Mount Cook, a splendid monolith 12,349 feet

high. Close to Mount Cook are its mighty rivals Mount Tasman, Mount Haidinger, and Mount La Perouse, which are all over 10,000



OUTLINE MAP OF NEW ZEALAND.

feet in height. Around these mountains and partly covering them is the huge "mer de glace," in which rise the principal glaciers of



FIG. 1.—DISTANT VIEW OF MOUNT COOK, CANTERBURY, N. Z.

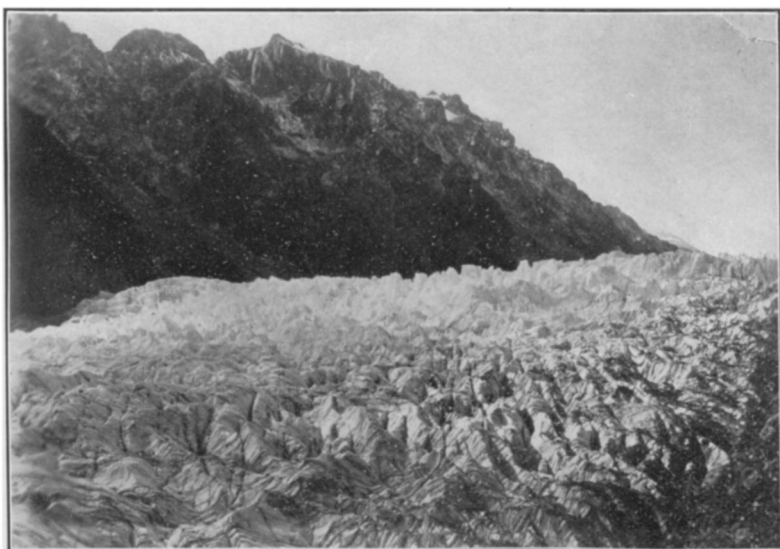


FIG. 2.—FOX GLACIER, WESTLAND, N. Z.



FIG. 3.—FRANZ JOSEF GLACIER, WESTLAND.



FIG. 4.—BALFOUR GLACIER, WESTLAND, N. Z.

New Zealand, flowing both to the Canterbury and the Westland sides of the Alps. North-eastward from Mount Harman the view discloses many lofty peaks, but, in general, there is a gradual diminution in height in this direction. Looking to the Canterbury side, one can see the mountains descend very abruptly at first, then more gradually for some miles, and finally disappear in the plains, at about 40 miles from the crest of the Alps. These plains, with remarkable evenness, continue to the seashore. The lower hills, lying just west of the plains, form the Foothills of the Alps. The wide, level stretch eastward to the sea is known as the Canterbury Plains. Towards the west the descent from the main crest of the Alps may be seen to be much steeper than on the eastern side, though at first it is less abrupt. On this side, also, parallel and branching ranges from the main ridge stand out less pronouncedly and are fewer in number than on the eastern side. Very little level land appears in Westland; but, bordering the sea, a narrow plain is visible, on which the town of Hokitika is situated. Towards the Alps this narrow plain is surmounted by many rounded hills, sometimes of sufficient altitude to be called mountains, which are outliers from the main ranges.

The fertile plains of Canterbury, almost devoid of timber, and easy of access, were settled in the early days of New Zealand colonization. The first settlement was made at Christchurch in 1848, and the settlers rapidly pushed westward, laying out farms and extensive sheep runs even on to the slopes of the Foothills. To-day the Canterbury Plains are dotted with splendid towns and villages and well-tilled farms. Roads run in every direction, and railroads connect the principal centres. For years after the settlement of New Zealand, Westland remained a wilderness. The dense forest which clothed the narrow plain did not tempt settlement from the sea-coast, and the Southern Alps formed an effective barrier from the east. It was only when alluvial gold-leads of astonishing richness were discovered near the mouth of the Hokitika River in 1865 that the first hardy pioneers found their way across the difficult mountain-passes and down the wild, rapid rivers to the Eldorado. Thousands of others came by sea. Mushroom towns grew up apace, and soon Hokitika had a population of nearly 20,000 people. All this transient glory has long since passed away, and Hokitika has faded into a broken-down town of some 2,000 inhabitants. Even yet there is comparatively little settlement on the West Coast, though the land is often rich, and it is only along the alluvial flats close to the principal rivers that one sees the scattered farms. The small com-

munity is an isolated one, the harbours on the sea-coast are poor, and there is only one main highway between the Canterbury Plains and the West Coast. This stage-road winds up the valley of the Waimakariri, and, crossing the Alps at Arthur's Pass, about ten miles north-east of Mount Harman, continues down along the broad valley of the Teremakau to the coast.

For years it has seemed to the Westland people that their dense forest has been the greatest drawback to their province, but in reality it is going to be one of their finest assets. Already timber is being exported. But it is not only in this direct way that the forest is to be of value. There is no doubt that the scenery of Westland is the most wonderful in New Zealand, and among the finest in the world, and the marvellous variety of the forest growth is its chief charm. It is this scenery which, by attracting thousands of tourists, will bring wealth to the West coast. The majestic *rimus*, *kahikateas*, and *totaras*, all giant conifers of magnificent shape; the beautiful dark-green, sweet-scented *rata*, covered with a moss of brilliant scarlet flowers for months in the year; the wonderful choice of ferns, from lacy filaments almost microscopic in size to huge tree-ferns towering 50 feet or more in height, with fronds even ten feet long; the stately cabbage-tree; the long-leaved nikau-palm; the innumerable pendent vines, creepers, and mosses; the brilliant Alpine flora—all these lend a fascination to the ever-changing forests of Westland which is quite lacking in the dreary, monotonous plains of Canterbury, and, owing to the marked difference of the flora of New Zealand from that of any other part of the world, give it a unique charm. The luxuriance of the vegetation is due to the mild, moist climate. The rainfall at Hokitika averages 120 inches a year; while it is only 25 inches at Christchurch, the lofty mountain-chain of the Alps precipitating the moisture brought by warm winds from the Tasman Sea, and thus preventing so large a rainfall on the Canterbury Plains. However, the actual number of rainy days at Hokitika is comparatively little more than at Christchurch, and no one can describe the brilliancy of the skies in Westland when the weather is fine; and weather of this sort, in which one can study the splendid sculpturing of the Alps, may last for weeks. The variety of the scenery is marvellous, and one is continually coming upon some new and charming feature—the deep gorges of the rivers; the innumerable splendid waterfalls, some of considerable volume, and many of tremendous height; the mountains with their tops capped with continual snow and ice; the great glaciers, stretching miles out from the mountains towards the sea: all these make

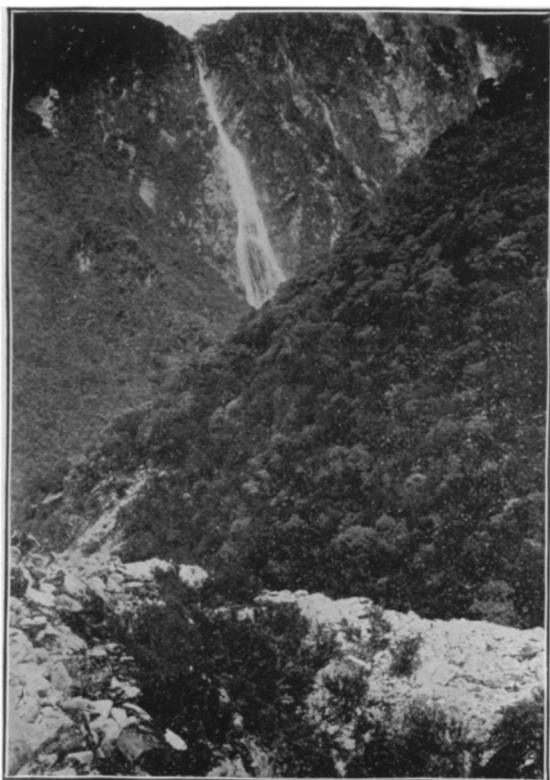


FIG. 5.—UNSER FRITZ FALL, NEAR FRANZ JOSEF GLACIER, WESTLAND.

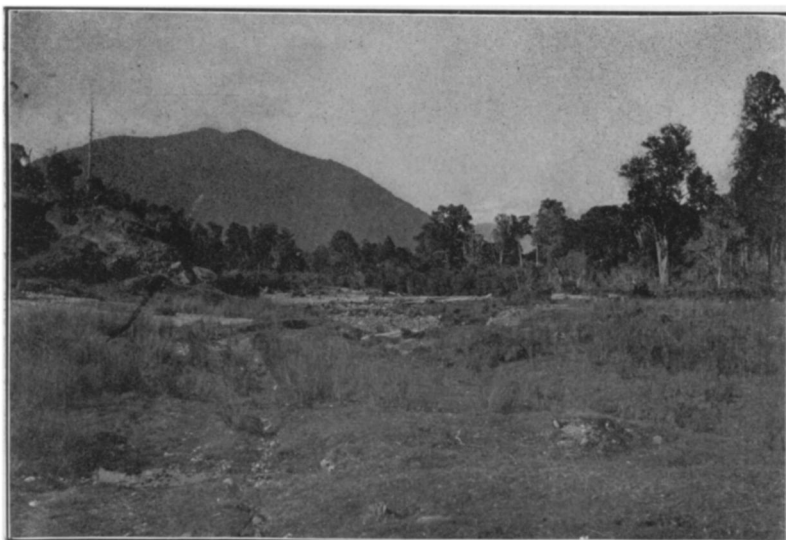


FIG. 6.—WESTLAND COASTAL PLAIN, SHOWING GRANITE OUTLIER.

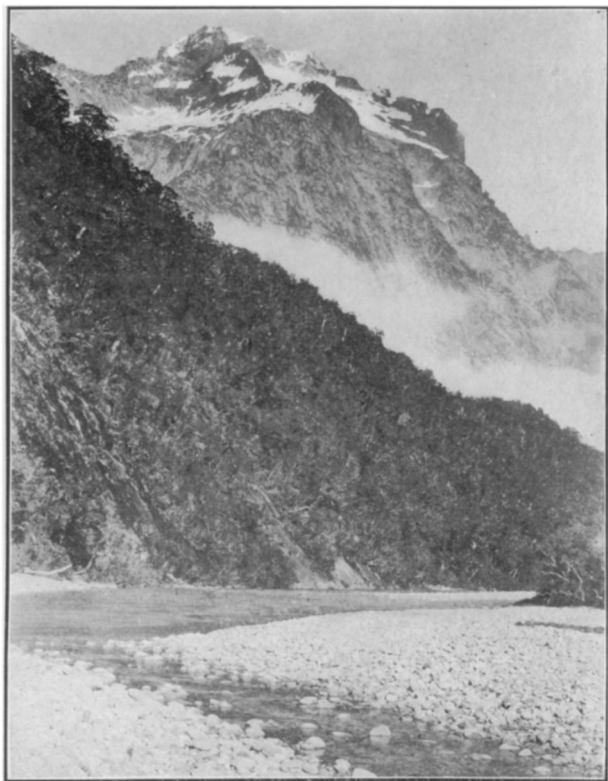


FIG. 7.—MOUNTAIN STREAM, WESTLAND.

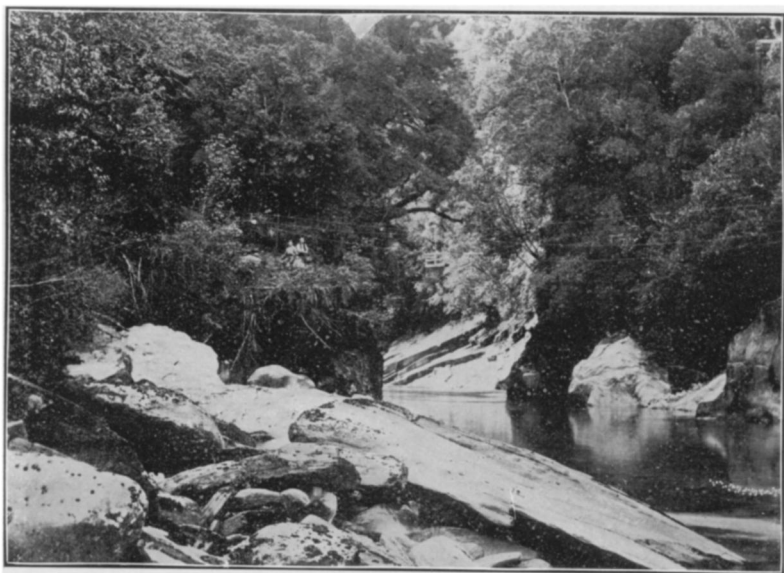


FIG. 8.—WESTLAND CREEK, N. Z.

an indescribably beautiful landscape set off in a wealth of marvellous foliage. From beneath the shade of immense tree-ferns one can look up on the mountains with their continuous white mantle and down into a broad valley filled by a glacier. One rather remarkable feature about the mountains of the West Coast is the lowness to which the snow-line descends. The line of constant snow is only about 6,000 feet above sea-level in the latitude of Hokitika, though it is higher on the Canterbury side. Yet snow falls only very rarely at Hokitika, while nearly every year an inch or more descends at Christchurch.

The geology of the region is simple. The *massif* of the Alps and of the Foothills consists, in the main, of greatly-altered Paleozoic sediments, with lesser amounts of Mesozoic, and possibly very early Tertiary sediments, and with minor intrusions of eruptive rocks of varying petrographical composition. The outliers on the western side of the mountains are Mount Tuhua, Mount Turiwhate, and the Hohonu Mountains, the remnants of an ancient granite range. The wide coastal plains on the Canterbury side and the narrow bench on the Westland side of the Alps are underlain by late Tertiary rocks, of gradual inclination towards the sea on either side. These strata are covered on the Canterbury side by glacial *débris*, and by immense thicknesses of gravels, thinnest at the mountain edge and increasing in thickness towards the sea. Near Christchurch, Banks Peninsula forms a decided break in the even coast-line. It is an area of rocks of volcanic origin, with characteristic well-formed craters, and other evidences of comparatively recent activity, though the exact age is unknown. The narrow plain of Westland is also covered by morainic material of heterogeneous character, and by fluvial and lacustrine gravels.

The edge of the plains on the Canterbury side is about 1,000 feet above the sea. The plains commence among the Alpine foothills, as wide river flats, which, on leaving the higher ground, widen into fan-shaped deltas. The deltas of the various streams unite at the edge of the hills to form the relatively vast stretches of the Canterbury Plains. The plains are of a fairly-rolling surface, and have a gradual but steady slope towards the east, down which the rivers rush in ever-changing courses. The descent of the rivers averages quite 30 feet per mile near the Alps, though it is not so great towards the sea. Gorges with falls and rapids occur where the rivers, often rising in glaciers, dash from the mountains to the plains. These falls do not occur at the actual borders of the old Paleozoic land, since the narrow river flats which mark the commencement of the

Canterbury Plains are closely bordered by the mountains, and represent merely the more rapid erosion by fluvial or glacial action than by sub-aerial decay. Along the various rivers wide, terraced flats show the successive levels of the streams in wearing down their channels to grade. Floods are of common occurrence on the lower river flats, especially towards the sea, and some serious inundations have destroyed great numbers of cattle and removed bodily many acres of very arable land.

On the Westland side the inner edge of the plain is also about 1,000 feet above sea-level, and hence its inclination to the sea is much more than that of the Canterbury Plains. The plain has been deeply scored by the glaciers which formerly flowed westward from the Alps; and though many of the glacial valleys were filled by morainic débris, the tremendous scouring of the many rivers is already rapidly wearing away the former plain, producing a new baselevel, above which the remnants of the former plain stand out with prominent relief. Still higher are the granite outliers of the old land, which were islands off the coast during the laying down of the late Tertiary sediments. Some of the larger streams, like the Teremakau, the Hokitika, and the Arahura, have wide stretches of river flats towards the sea. At the junction of the Hokitika and its two large tributaries—the Kokatahi and the Styx—the flat is approximately 10 miles across, and this towards the sea unites with the new coastal bench, several miles wide. Many relatively recent alterations in the drainage channels are very evident, though some of the rivers occupy ancient valleys. The Upper Teremakau probably flowed at some remote period east of the ancient granite range into the Arahura; later it flowed north by Lake Brunner. Its present channel is probably of recent formation, and thus the valley of the large and powerful Teremakau, though followed by a glacier in glacial times, is still comparatively narrow between the Turiwhate Range and the Hohonu Range. A small river known as the Orangipuku, which flows into Lake Brunner from the south, runs along the former channel of the Teremakau, and in one part of its course flows within 300 yards of the larger river, and practically on the same level. In addition, immense springs bubble up through the bouldery banks, along the Orangipuku, and their water evidently comes from the Teremakau, as the quantity which they put forth depends directly upon the amount of water in the Teremakau.

The lakes of Westland are very interesting, and show strikingly

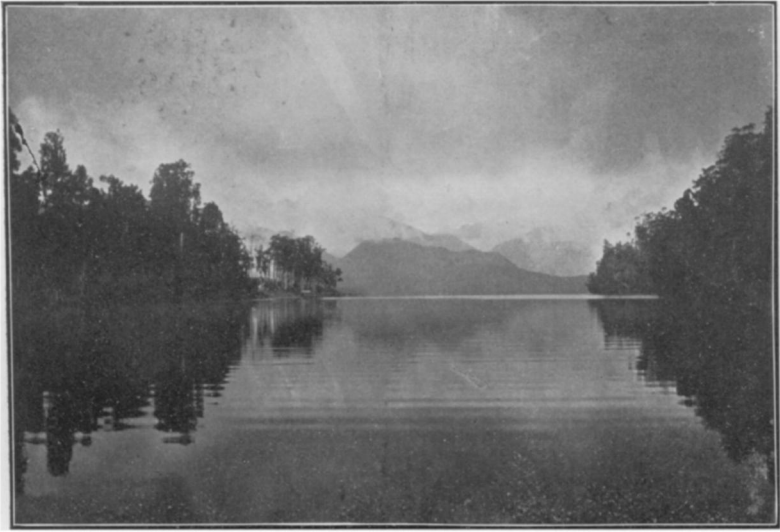


FIG. 9.—LAKE KANIERI, WESTLAND, N. Z.



FIG. 10.—SOUTHERN ALPS, WESTLAND, SHOWING A MORaine ON THE ICE, A VERY RARE FEATURE ON THE WESTLAND SIDE.

the pronounced influence of glaciation. Lake Kanieri is a beautiful sheet of water, with rough, rocky shores, bordered by a thick luxuriant foliage. The beauty of the lake is enhanced by the dark green of wooded hills, some thousands of feet in height, which immediately surround it, and by the magnificent snow-clad peaks of the Alps, which rise in stately splendour in the background. The basin of Lake Kanieri occupies an ancient river valley. During the period of maximum glaciation a glacier descended the Styx River and sought a passage northward through the valley now occupied by Lake Kanieri. Glaciers also flowed from the hills on the east and west of the lake. The effect of the union of the several glaciers has been the formation of a very deep trough, with a relatively even and almost level bottom. Soundings recently made by Mr. P. G. Morgan, of the Geological Survey of New Zealand, show that the greatest depth of the lake is 646 feet. As the surface of Kanieri Lake is some 422 feet above sea-level, the bottom is 224 feet below the surface of the ocean. The water of Lake Kanieri is dammed back by an immense terminal moraine at its northern end. Formerly this moraine turned the drainage in the opposite direction from that of the preglacial river, and the water sought exit by a channel flowing up the old valley into the present valley of the Styx. Then there came an immense slip from mountains to the east, which closed the passage to the Styx, and the lake sought exit over the lowest part of the moraine, or practically along the old Styx River valley. A lake of very similar origin to Lake Kanieri is Lake Coleridge in Canterbury, which drains to the Wilberforce. The lake occupies an ancient glacial valley, with its long axis parallel to the course of the Rakaia.

Lake Ellesmere on the Canterbury coast is quite different in origin from Lake Kanieri and Lake Coleridge. It is practically a shallow lagoon dammed off from the sea by a broad sand-bank. The lake was formerly a bay bordered on the north and north-east by Banks Peninsula, and the bank across its mouth has been produced by the sweep of the northward current which flows along the coast. The Totara Lagoon on the Westland coast is of similar origin, and Lake Mahinapua, which in time of flood receives the waters of the Hokitika River, is also to some extent the result of a current sweeping along the west coast, though in part it is dammed by morainic material. It is relatively a shallow lake, of dark-brown swampy water, of great scenic interest owing to the magnificent forest growth which surrounds it.

Browning's Pass is a broad U-shaped elevated trough, bordered by the rugged slopes of Mount Harman on the north and by the precipitous cliffs of Mount Hall on the south. Both are capped with perpetual snow, and from Mount Hall the Hall Glacier descends over an ice-fall into the huge cirque in which rises one of the tributaries of the Wilberforce River. Other tributary streams flow with steep falls from the slopes of Mount Harman into the cirque basin, which is some 1,600 feet below the level of Browning's Pass, or about 3,000 feet above sea-level.

Lake Browning on the summit of Browning's Pass, a somewhat shallow depression, a quarter of a mile in diameter, now forms the headwaters of the Arahura River, though it formerly drained over the lip of the pass into the Wilberforce. On the Arahura side, below Browning's Pass, is another great cirque, in which the Arahura receives several small tributaries, with steep, high falls from the surrounding mountains. One of its most interesting features is the low ridge, which borders it to the west, and through which the Arahura has cut a narrow gorge. Standing on the mountains on either side, one can easily trace the broad U-shaped valley on its course towards the sea, in which the narrow V-shaped valley is being incised.

Owing to the enormous rainfall on the West Coast, denudation is rapid. Immense rock-slides from the mountain sides continually descend into the rivers, and huge talus fans are rapidly filling up even the deepest lakes. The scenery of the Upper Arahura is magnificent in the extreme. From the summit of Styx Saddle, a grassy pass which leads from the Arahura to the Styx, one can look down on the broad, ancient glacial valley, wooded—the timber gradually disappearing upward and lost in scraggy ratas, mountain cabbage-trees, etc.—then above the snowgrass, and still higher the mantle of snow, from which protrude the dark-colored jagged *nunataks*. Away up the valley of the Arahura are the lofty giants of Mount Harman and Mount Hall, the jagged peaks covered with snow, and with here and there a flat, free from protruding rocks, indicating a small glacier. Down the valley one can see numerous falls leap hundreds of feet from wild, unexplored valleys, in magnificent cascades, into the main river.

Many years ago the Maori chiefs crossed the Alps at Browning's Pass, and descended their sacred river, the Arahura, in search of the precious greenstone (nephrite), from which their ornaments and war axes were made. Recently the discovery of auriferous quartz veins, on the western slopes of Mount Harman, has necessitated the construction of a rough mountain trail by the European inhabitants

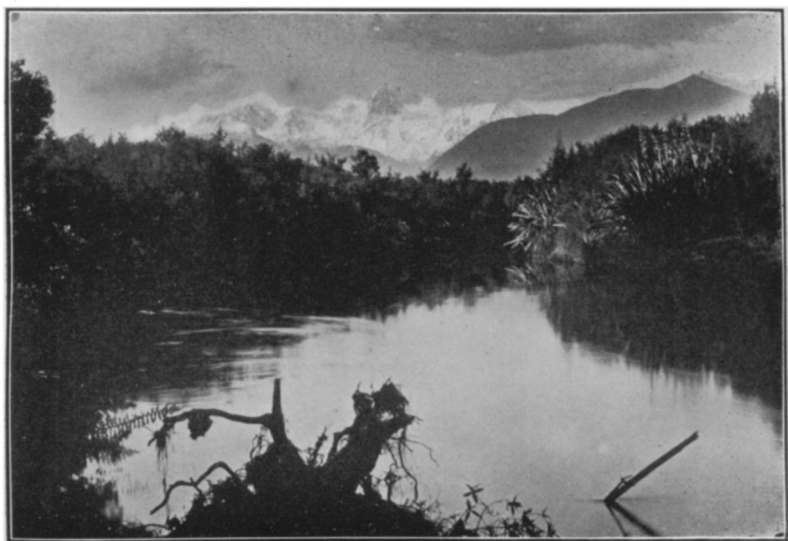


FIG. 11.—LAGOON, SOUTH WESTLAND, N. Z.



FIG. 12.—SOUTHERN ALPS, WESTLAND, N. Z.

of New Zealand, over the same route followed so many generations ago by the Maori warriors.

JAMES MACKINTOSH BELL,
Director of the Geological Survey of
New Zealand.

Wellington, 30th September, 1905.

MAPS OF MEXICO.

BY

F. J. H. MERRILL.

The person who, through scientific or commercial interest, seeks accurate cartographic information about Mexico,—or, indeed, accurate information about Mexican maps—meets with many difficulties. Libraries, as a rule, do not consider it important to keep in touch with the progress of maps and map-making; book-sellers handle only those maps which are made known by advertising and yield a liberal profit in handling, and commercial map-publishers can make a large profit from an untrained public by putting new dates on old map-plates. The inquirer, therefore, after wasting some time, ascertains that the preparation and publication of accurate maps has become a branch of Government work in Mexico, as in many other countries, and that information must be obtained from the Government Bureau in charge.

Our sister Republic, with its enormous extent of unsettled territory, is pushing to completion, as rapidly as possible, its topographic survey, which has been in progress more than twenty years, and will, in time, result in covering its territory with a series of sheets on the scale of 1:100,000, each including about 15' of latitude and about 30' of longitude.

As these will be, for a long time to come, the only accurate maps for the use of the public, a brief description will be of interest. The official key map shows the following divisions and prospective series: A. Nine sheets on the scale of 1:2,000,000, designated by large Arabic numerals. B. Twenty-four sheets on the scale 1:1,000,000, designated by small Arabic numerals from 1 to 24, beginning at the N. W. corner. C. Ninety-six sheets on the scale of 1:500,000, each of the sheets of series B being divided into four equal parts, designated by Roman numerals from I to IV. Of this